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Photons probe entropic potential variation during molecular confinement in nanocavities

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2018 by the authors. In thin polymeric layers, external molecular analytes may well be confined within tiny surface nano/microcavities, or they may be attached to ligand adhesion binding sites via electrical dipole forces. Even though molecular trapping is followed by a variation of the entropic potential, the experimental evidence of entropic energy variation from molecular confinement is scarce because tiny thermodynamic energy density diverseness can be tracked only by sub-nm surface strain. Here, it is shown that water confinement within photon-induced nanocavities in Poly (2-hydroxyethyl methacrylate), (PHEMA) layers could be trailed by an entropic potential variation that competes with a thermodynamic potential from electric dipole attachment of molecular adsorbates in polymeric ligands. The nano/microcavities and the ligands were fabricated on a PHEMA matrix by vacuum ultraviolet laser photons at 157 nm. The entropic energy variation during confinement of water analytes on the photon processed PHEMA layer was monitored via sub-nm surface strain by applying white light reflectance spectroscopy, nanoindentation, contact angle measurements, Atomic Force Microscopy (AFM) imaging, and surface and fractal analysis. The methodology has the potency to identify entropic energy density variations less than 1 pJm-3and to monitor dipole and entropic fields on biosurfaces.

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Keywords

157 nm laser, Atomic Force Microscopy, Electric dipole interactions, Entropy, Fractal analysis, Nanoindentation, Nanothermodynamics, PHEMA, Water contact angle, White light reflectance spectroscopy

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